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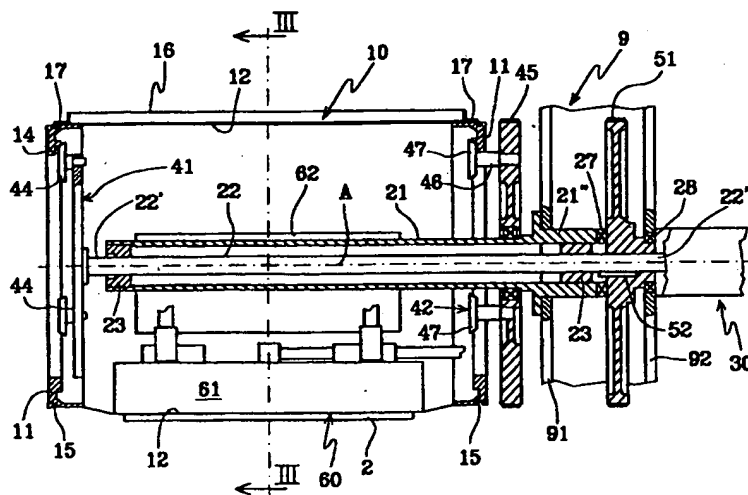
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(54) Title: SILK-SCREEN PRINTING MACHINE WITH ROTARY CYLINDRICAL SCREEN



(57) Abstract

The machine comprises a screen (12) of drum form comprising two rigid annular elements (11), positioned on the two flat ends and arranged to maintain the screen surface under axial tension; there are also provided a horizontal outer shaft (21) rigid with the fixed structure (9) and projecting from it, and an inner shaft (22) coaxial with and movable axially relative to the outer shaft (21) and inserted telescopically into this latter, and having a front end (22') projecting from the front end of the outer shaft (21); a first group (41) of radial means being fixed to the end (22') of the inner shaft (22); a second group (42) of radial means being rotatably and coaxially coupled to the outer shaft (21); said groups (41, 42) of radial means being arranged to press axially against the two annular elements (11) of the drum (10) in such a manner as to withdraw them from each other in an axial direction; a thrust means (30) being provided to move the inner shaft (22) axially to the outer shaft (21), and a motion transmission system for rotating with the same motion both the groups (41, 42) of radial means.

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DescriptionSilk-screen printing machine with rotary cylindrical screenBackground art

Machines for silk-screen printing using a cylindrical screen have been known for a considerable time, comprising a device in the form of a drum with two rigid annular elements positioned on two flat ends, and arranged to maintain a perforated cylindrical surface defining the printing screen under axial tension. There are also provided means for advancing the objects in succession under the drum, and a fixed structure for supporting the drum with its axis horizontal so that the screen can act on the objects. During its operation, the drum is rotated about its axis while the objects advance tangentially to the screen, with the same velocity as this latter, so that exact rolling of the cylindrical screen along the upper surface of the object is achieved. In the meantime, doctor means positioned within the drum squeeze the ink through the holes in the screen, so transferring it to the objects.

Machines of this type have various advantages, including a high production rate.

The object of the present invention is to provide a machine of the said type, in particular able to operate on ceramic tiles, which represents an improvement on known machines, in particular in terms of accelerating and simplifying the mounting and demounting of the drum.

Disclosure of the invention

Said object is attained by the machine according to the invention, as characterised in the claims.

The invention is described in detail hereinafter with the aid of the accompanying figures, which illustrate one non-exclusive embodiment thereof.

Figure 1 is a section through the machine taken on the axial vertical plane A.

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Figure 2 is a section through the machine taken on the axial horizontal plane A.

Figure 3 is a section on the plane III-III of Figure 1.

Figure 4 is a section through a detail of Figure 3 taken on the plane IV-IV.

Figure 5 is a section such as that of Figure 4 but showing a different embodiment of the drum device 10.

Figure 6 is a view in the direction of the arrow VI of Figure 5.

The illustrated machine comprises a device 10 of drum form comprising two rigid annular elements 11 defining the two flat ends of the device, to the outer periphery of which there is fixed a silk screen 12 of cylindrical shape which is maintained under axial tension by the annular elements 11 so that it assumes said cylindrical shape.

The machine also comprises means for advancing the objects 2 in succession under the drum device 10, tangentially to the screen 12.

In particular, if the objects to be treated are ceramic tiles, these means consist of strap or belt conveyor means.

The machine also comprises a fixed structure 9 for supporting the drum with its axis A horizontal to enable the screen to operate on the objects 2.

According to the invention, there are provided a horizontal outer shaft 21 rigid with the fixed structure 9 and projecting from it, and an inner shaft 22 the axis of which is identical with the axis of the outer shaft 21 and with the drum axis A.

The shaft 22 can move axially to the outer shaft 21 and is inserted telescopically therein, it having its front end 22' projecting from the front end of the outer shaft 21.

The rear portion of the outer shaft 21 is fixed to a vertical plate 91 of the fixed structure 9, that portion of the shaft 21 which projects frontwards from the plate 91 being freely jutting. With the inner shaft 22 there is associated a thrust means 30 arranged to move it axially to the outer shaft 21. The thrust means 30 comprises a pneumatic cylinder-piston unit 31 the outer casing of which is fixed to a second plate 92 parallel to the

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first and forming part of the fixed structure 9. The cylinder-piston unit 31 has a double rod 32 which moves in the direction of the axis A and prismatically engages the outer casing of the cylinder-piston unit itself. At the end of the rods 32 there is  
5 provided a bearing 33 which rotatably supports the rear end 22" of the inner shaft 22 while restraining it axially.

The inner shaft 22 is secured to the outer shaft 21 by a pair of radially acting supports 23 positioned at the two ends of the shaft 21 and enabling the shaft 22 both to rotate and to slide  
10 axially. To the free end of the inner shaft 22 there is fixed a first group 41 of radial means coaxial to the shaft 22. A second group of radial means 42 is rotatably and coaxially coupled to the outer shaft 21.

The first group 41 of radial means comprises radial spokes 43 the central hub of which is rigidly fixed to the inner shaft 22. To  
15 the outer end of the spokes 43 there are fixed a like number of abutment members 44 projecting axially forwards from the spokes 43. Specifically, said members 44 are in the form of discs the lateral surface of which is frusto-conical with the taper directed  
20 forwards. The second group of radial means 42 comprises a transmission wheel 45 coaxial to the axis A and to the front of which there are fixed a number of short stems 46, parallel to A, which project forwards and carry respective abutment members 47 identical to the members 44 and having their taper extending  
25 rearwards.

The members 44 are angularly equidistant about the axis A and are positioned at the same distance from the axis A. An identical geometrical arrangement is provided for the members 47. Each member 44 is aligned axially with a respective member 47.

30 In particular, the members 44 and 47 are mutually identical, are circular in plan view and are of frusto-conical lateral surface. Said annular elements 11 are mutually identical, each having a wide central mouth 13 and being shaped to enable the radial means 44 and 47 to pass axially through said mouths 13 when the drum is  
35 located in a first angular position relative to the groups 41 and 42, but to couple together the radial means 44 and 47 and the

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annual elements 11 on rotating the drum 10 into a second angular position. In particular, each mouth 13 has a substantially circular contour with a plurality of slots 13' (of lunette shape) along this contour, enabling the members 44 and 47 to pass through them.

In addition the annular elements 11 comprise abutment seats 14 positioned at the boundary with the mouth 13 and shaped to receive the members 44 and 47 as an exact fit to provide self-centering action. Specifically, the seats 14 are in the form of non-through cavities positioned in the rear face of the annular elements 11 and having in frontal view the shape of a circular segment substantially identical with that portion of the member 44, 47 which it supportingly receives; they are hence of lunette shape with a frusto-conical lateral edge.

The seats 14 are positioned in the same geometrical relationship to the axis A as the abutment members 44 and 47.

With the groups 41 and 42 there is associated a movement transmission system arranged to rotate both the groups 41 and 42 with the same motion.

This movement transmission system comprises a transmission wheel 51 secured to the inner shaft 22 in such a manner as to rotate rigidly with it but be able to slide axially to it. Specifically, the wheel 51 is coaxial to the shaft 22 and is axially clamped between the rear end 21" of the shaft 21 and the front face of the plate 92. Suitable axially acting bearings 27 and 28 are positioned within the contact regions between the wheel 51 and this end 21" and the plate 92, for the rotation of the wheel 51.

The wheel 51 is mounted directly on the inner shaft 22 and is made rotatably rigid therewith by the application of a longitudinal key 52 which enables the shaft 22 to move axially whereas the wheel 51 remains axially fixed.

A second transmission wheel is formed by said wheel 45 which is idly coupled to the outer shaft 21 and is rigidly joined to the second group 42 of radial means.

The two wheels 45 and 51 are rotatably connected, for example by toothed transmission belts 52, to respective transmission wheels

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54 and 55 respectively, both keyed onto the same shaft 56, supported by the plates 91 and 92 and driven by the same geared motor 57.

To rotate both the groups 41 and 42 with the same motion, the two  
5 wheels 45 and 51 have the same pitch circle diameter, as have the two wheels 54 and 55.

The annular elements 11 each have an outer annular groove 15 with a radially extending cross-section. The drum device 10 also comprises a plurality of struts 16 (in practice two struts 16 are  
10 sufficient), to be interposed between the annular elements 11 on the outside of the cylindrical surface 12 to maintain the two annular elements 11 axially distant from each other. At their ends they comprise respective profiled elements 17 to be inserted into said outer grooves 15 (see Figure 4 in particular).

15 When the drum device 10 is not mounted on the machine (during transportation, during storage, during washing etc.) the two annular elements 11 are maintained distant from each other by the struts 16, which maintain the drum device 10 and the screen 12 in extended form to prevent this latter undergoing damaging creasing.  
20 In a further embodiment, shown in Figures 5 and 6, the annular elements 11 each comprise, on the outer cylindrical surface, a plurality (in practice two are sufficient) of seats 151 forming in cross-section an abutment seat for profiled elements 171 positioned on the ends of the struts 16.

25 Each seat 151 comprises a locator element 152, for example consisting of an axial pin fixed into the annular element and projecting outwards into the seat 151. Again in this case there are provided a plurality of struts 16 (two in practice), which are interposed between the annular elements 11 on the cylindrical  
30 surface 12, to maintain the two annular elements 11 axially distant from each other, with the surface 12 hence properly extended.

At their ends the struts 16 comprise respective profiled elements 171 to be inserted into said outer seats 151 so as to become fixed  
35 in the angular grooves formed by them. The elements 171 also possess a small slot to mate with the locator element 152. The

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seats 151 plus relative locator elements 152 of one annular element 11 are positioned in the same angular relationship as those of the other annular element 11, the silk screen 12 being fixed to the annular elements 11 in a manner concordant with the locator elements. Consequently when a drum device 10 is maintained extended by the struts 16 positioned in the respective seats 151, this ensures that the screen 12 is also correctly extended in the axial direction of its generators. In other words, the screen is prevented from undergoing twisting about the axis A, with the danger of stretching.

For mounting, the drum device 10 is moved with axial movement from left to right in Figures 1 and 2, so as to cause the shafts 21 and 22 to penetrate into the drum device 10. During this stage, the drum device 10 is retained in a first angular position such that the slots 13' of the two annular elements 11 are aligned in an axial direction with the members 44 and 47.

While retaining it manually in this position, the operator moves the drum device 10 towards the right, hence making both the first group 41 and the members 47 of the second group 42 pass through the mouth 13 and the slots 13' of the right annular element 11. Then, while all the members 44 and 47 are positioned within the drum device 10, this is rotated manually about the axis A into a second position in which the members 44 and 47 are axially aligned with the seats 14.

At this point the cylinder-piston unit 31 is operated to move the inner shaft 22 forward and hence withdraw the first group of radial means 41 from the second group of radial means 42 in an axial direction. The members 44 hence move into abutment against the left annular element 11, within the seats 14 of this latter, whereas the members 47 move into abutment against the other annular element 11 within its seats 14, the screen 12 being subjected to the required axial tension to maintain it in the required geometrical form. At this point the struts 16 cease to be stressed because the tension provided by the cylinder-piston unit 31 is greater than that provided by them, so that they can be removed



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Because of the frusto-conical shape of the members 44 and 47, these adapt to the respective seats 14 with a self-centering action, so achieving great precision in the relative geometrical arrangement between the groups 41 and 42 and the annular elements 11.

Withdrawal of the drum device 10 is achieved in the opposite manner to its insertion.

As the screen is tensioned by the thrust of the cylinder-piston unit 31, and as this is constant, the tension in the screen remains constant when external conditions vary.

In particular, suitable means (of known type, not shown in the figures) are provided for maintaining the pressure of the pneumatic cylinder-piston unit 31 constant and controlled at a suitable value for correct extension of the silk screen. The screen 12 is hence maintained extended with a constant thrust, which enables any yielding of the screen to be taken up and achieve extension under optimum force.

In operation, the two wheels 45 and 51 rotate exactly at the same velocity, as hence do the two groups 41 and 42; the drum device 10 hence rotates as a rigid body, which is precisely what is required.

Within the drum device 10 there are located suitable doctor means 60 supported by the outer shaft 21 and comprising a usual blade 61 for squeezing the enamel/ink onto the objects through the screen 12. Suitable motor means 62 are provided to adjust the radial position of the blade 61.

The space between the inner shaft 22 and the outer shaft 21 is suitably used for the passage of enamel feed conduits and electric cables.

By virtue of the invention, the drum device 10 is both mounted in and demounted from the machine by movement in the direction of the axis A; and as the doctor means 60 are of such a size as not to project radially outwards beyond the spokes 43, said means 60 do not hinder the mounting/demounting of the drum device 10, it hence not being necessary to remove them during these operations.

In addition, these operations are simple and quick in themselves,

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as screwing/unscrewing of bolts or like means are not required, merely a few manual movements plus operation of the cylinder-piston unit 31.

Moreover, by virtue of the invention, when the drum device 10 is  
5 in the mounted state its outer surface is freely accessible from all sides, this being advantageous because it facilitates the washing of the drum device 10. Furthermore, as the struts of the invention are external to the drum device 10, they are easy to handle and also protect the cylindrical surface (screen 12)  
10 against impact.

Numerous modifications of an practical and applicational nature can be made to the invention, but without leaving the scope of the inventive idea as claimed hereinafter.

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Claims

1. A silk-screen printing machine with a rotary cylindrical screen, in particular for ceramic tiles, comprising:  
a device (10) of drum form comprising two rigid annular elements (11), positioned on the two flat ends and arranged to maintain a  
5 perforated cylindrical surface defining the printing screen (12) under axial tension; means for advancing the objects (2) in succession below the drum (10); and a fixed structure (9) for supporting the drum (10) with its axis (A) horizontal so that the screen can act on the objects; characterised by comprising:
- 10 - a horizontal outer shaft (21) rigid with the fixed structure (9) and projecting from it,  
- an inner shaft (22) coaxial with and movable axially relative to the outer shaft (21) and inserted telescopically into this latter, and having a front end (22') projecting from the front end  
15 of the outer shaft (21),  
- a first group (41) of radial means fixed to the front end (22') of the inner shaft (22) and coaxial therewith,  
- a second group (42) of radial means rotatably and coaxially coupled to the outer shaft (21);
- 20 - said groups (41, 42) of radial means being arranged to press axially against the two annular elements (11) of the drum (10) in such a manner as to withdraw them from each other in an axial direction;  
- a thrust means (30) arranged to move the inner shaft (22)  
25 axially to the outer shaft (21),  
- a motion transmission system arranged to rotate with the same motion both the groups (41, 42) of radial means.
2. A machine as claimed in claim 1, characterised in that:  
30 in each group (41, 42), the radial means (44, 47) are angularly equidistant about the axis (A) of the shafts (21, 22) and are positioned at the same distance from the said axis (A);  
said annular elements (11) each having a wide mouth (13) and being shaped to enable the radial means (44, 47) to pass through them in

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an axial direction when the drum (10) is located in a first angular position relative to the groups (41, 42) of radial means, but to couple the radial means (44, 47) and the annular elements (11) together following rotation of the drum (10) into a second angular position.

3. A machine as claimed in claim 2, characterised in that each group (41, 42) of radial means comprises support means (43, 45) carrying a plurality of abutment members (44, 47) projecting radially outwards from the support means, the annular elements (11) having abutment seats (14) positioned in identical angular relationship about the axis (A) to the abutment members (44, 47) and shaped to receive the members (44, 47) as an exact fit with self-centering action, they also comprising mouths (13, 13') shaped to allow the support means (43, 45) and the relative abutment members (44, 47) to pass.

4. A machine as claimed in claim 1, characterised in that the motion transmission system comprises a first motion transmission wheel (53) secured to the inner shaft (22) in such a manner as to rotate rigidly with it but be able to slide axially to it; a second transmission wheel (45) being idly coupled to the outer shaft (21) and be rigidly joined to the second group (42) of radial means.

5. A machine as claimed in claim 1, characterised in that: the outer shaft (21) is supported by and projects from the fixed structure (9); the inner shaft (22) is slidably engaged within the outer shaft (21); the thrust means (30) comprises a pneumatic cylinder-piston unit (31), the rod of which is secured axially slidable to the fixed structure (9), at the end of the rod there being positioned a bearing (33) rotatably supporting the rear end of the inner shaft (22).

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6. A machine as claimed in claim 5, characterised by comprising means for maintaining the pressure of the pneumatic cylinder-piston unit constant and controlled at a suitable value for correct extension of the silk screen.

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7. A drum device for the machine claimed in claim 2, characterised in that said annular elements (11) each have a wide mouth (13) and are shaped to enable the radial means (44, 47) to pass through them in an axial direction when the drum (10) is located in a first angular position relative to the groups (41, 42) of radial means, but to couple the radial means (44, 47) and the annular elements (11) together following rotation of the drum (10) into a second angular position.

8. A drum device as claimed in claim 7, characterised in that the annular elements (11) have abutment seats (14) positioned in identical angular relationship about the axis (A) to the abutment members (44, 47) and shaped to receive the members (44, 47) as an exact fit with self-centering action, they also comprising mouths (13) shaped to allow the support means (43, 45) and the relative abutment members (44, 47) to pass.

9. A drum device as claimed in claim 7, characterised in that:  
each mouth (13) is of substantially circular contour with, along this contour, a plurality of slots (13') which allow the abutment members (44 and 47) to pass through them;  
the abutment seats (14) being in the form of non-through cavities located in the rear face of the annular elements (11) along the contour of the mouth (13) and having, in frontal view, the shape of a circular segment substantially identical to that portion of the abutment member (44, 47) which it supportingly receives.

10. A drum device for the machine claimed in claim 1, characterised in that:  
said annular elements (11) each comprise an outer annular groove

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(15) with a radially extending cross-section, the drum device also comprising a plurality of struts (16) to be interposed between the annular elements (11) on the outside of the cylindrical surface (12) to maintain the two annular elements (11) axially distant from each other, which latter at their ends comprise respective profiled elements (17) to be inserted into said outer grooves (15).

11. A drum device for the machine claimed in claim 1, characterised in that:

said annular elements (11) each comprise in their outer cylindrical surface a plurality of outer seats (151) comprising a locator element (152) and forming in cross-section an abutment seat for profiled elements (171) positioned on the ends of struts (16),

the drum device also comprising a plurality of struts (16) to be interposed between the annular elements (11) on the outside of the cylindrical surface (12) to maintain the two annular elements (11) axially distant from each other, which latter at their ends comprise respective profiled elements (17) to be inserted into said outer seats (151) to mate with the locator element (152), the locator elements (152) of one annular element (11) being positioned in the same angular relationship as those of the other annular element (11), the silk screen 12 being fixed to the annular elements (11) in a manner concordant with the locator elements.

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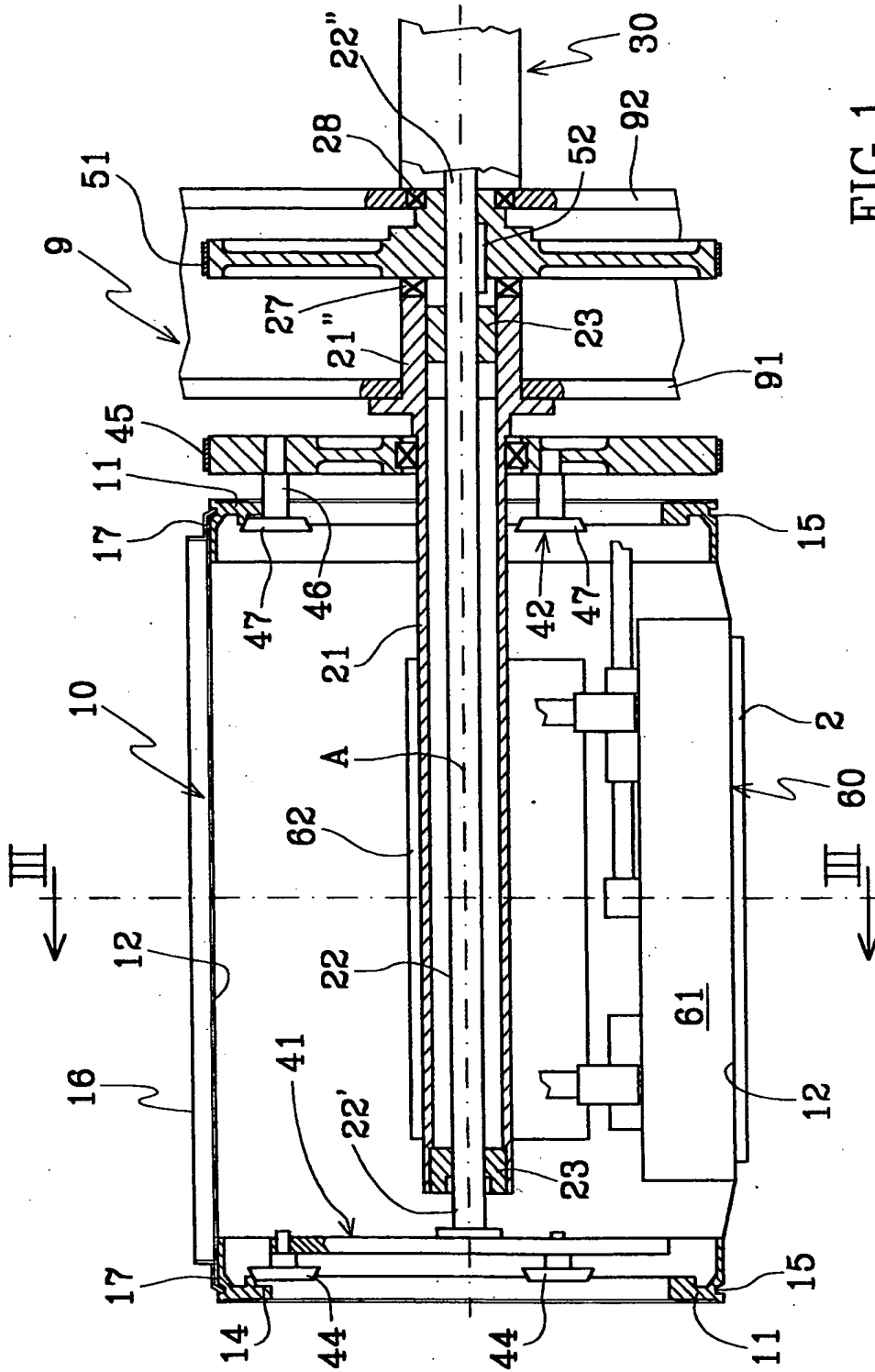
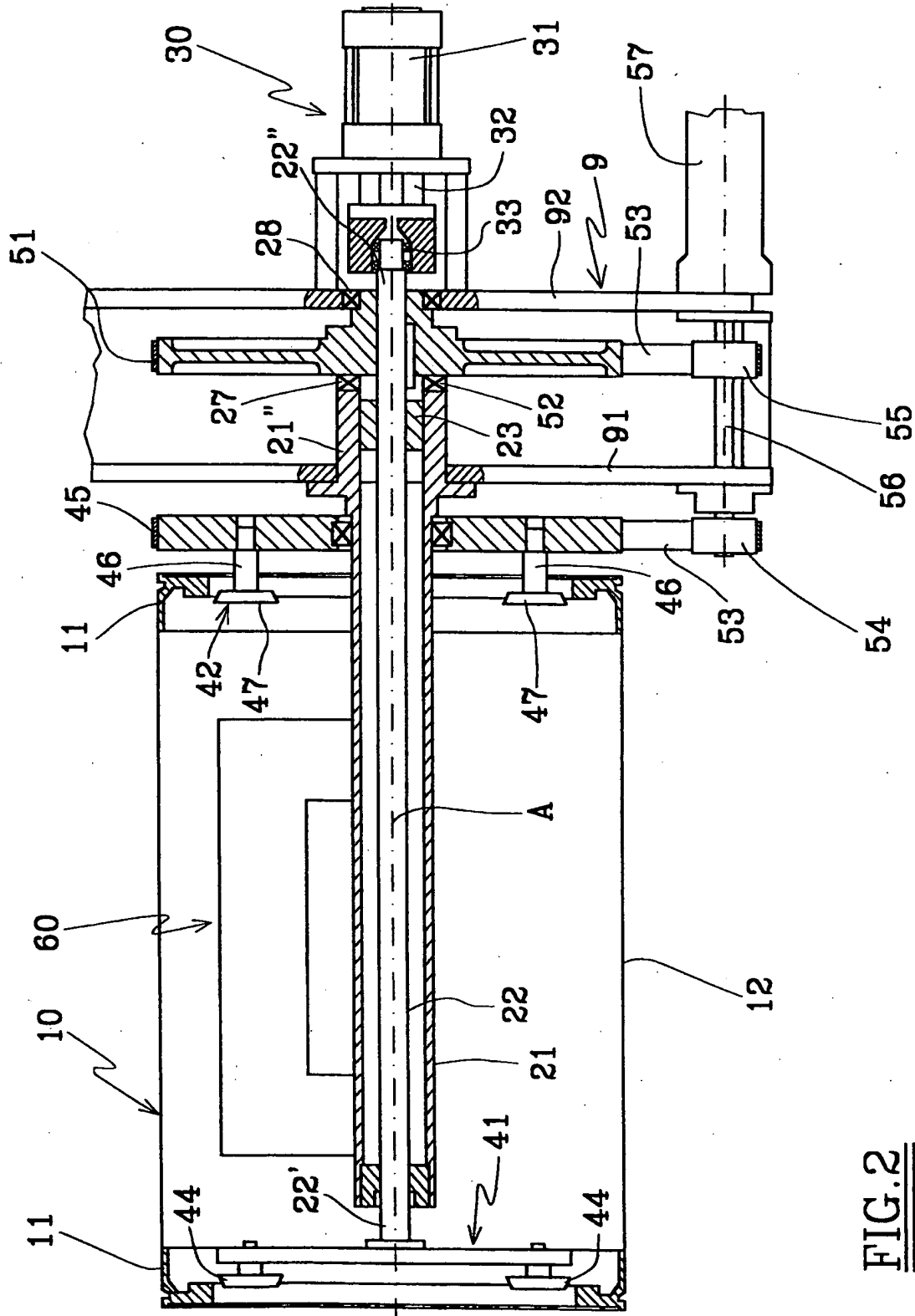


FIG. 1

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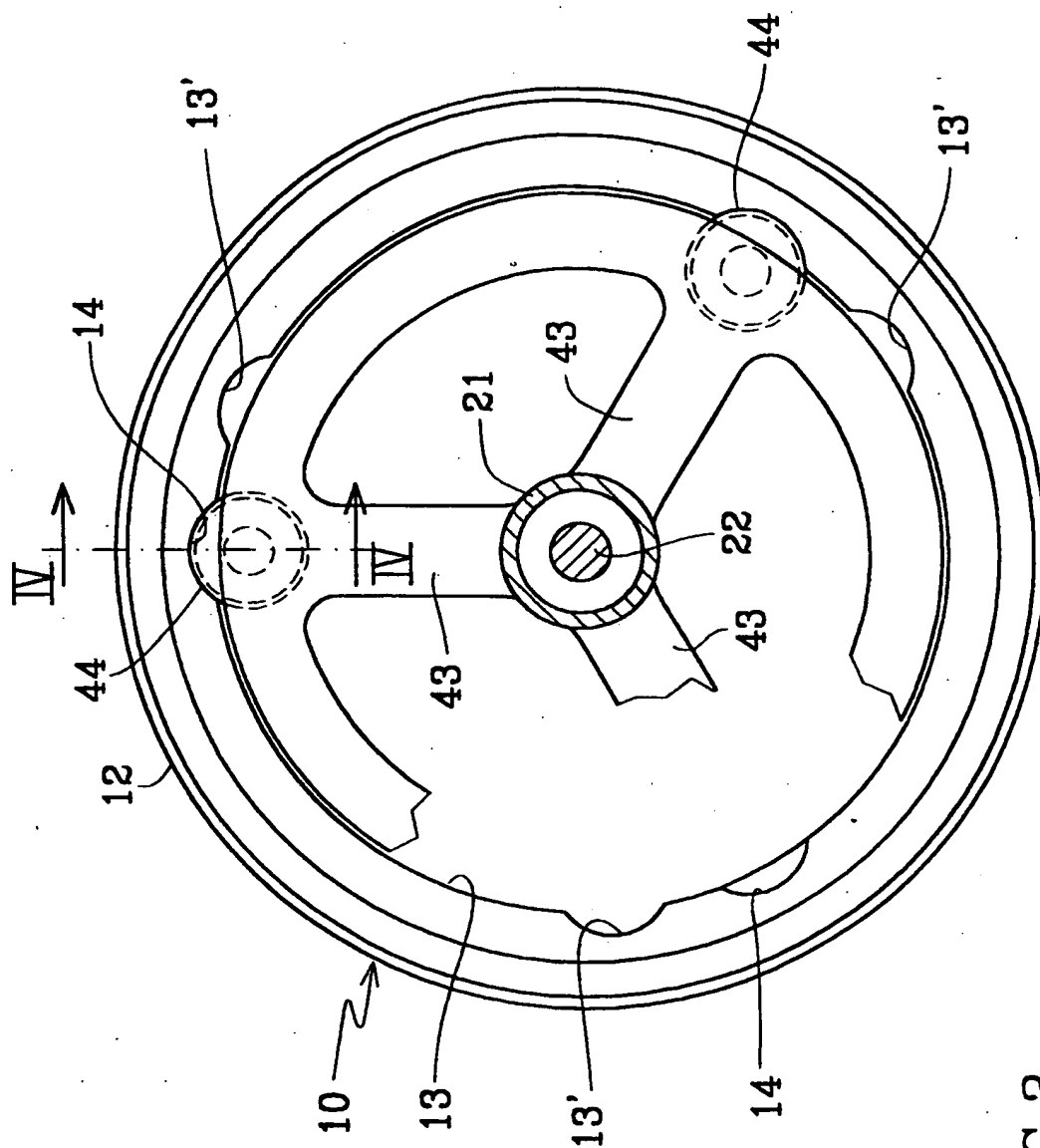
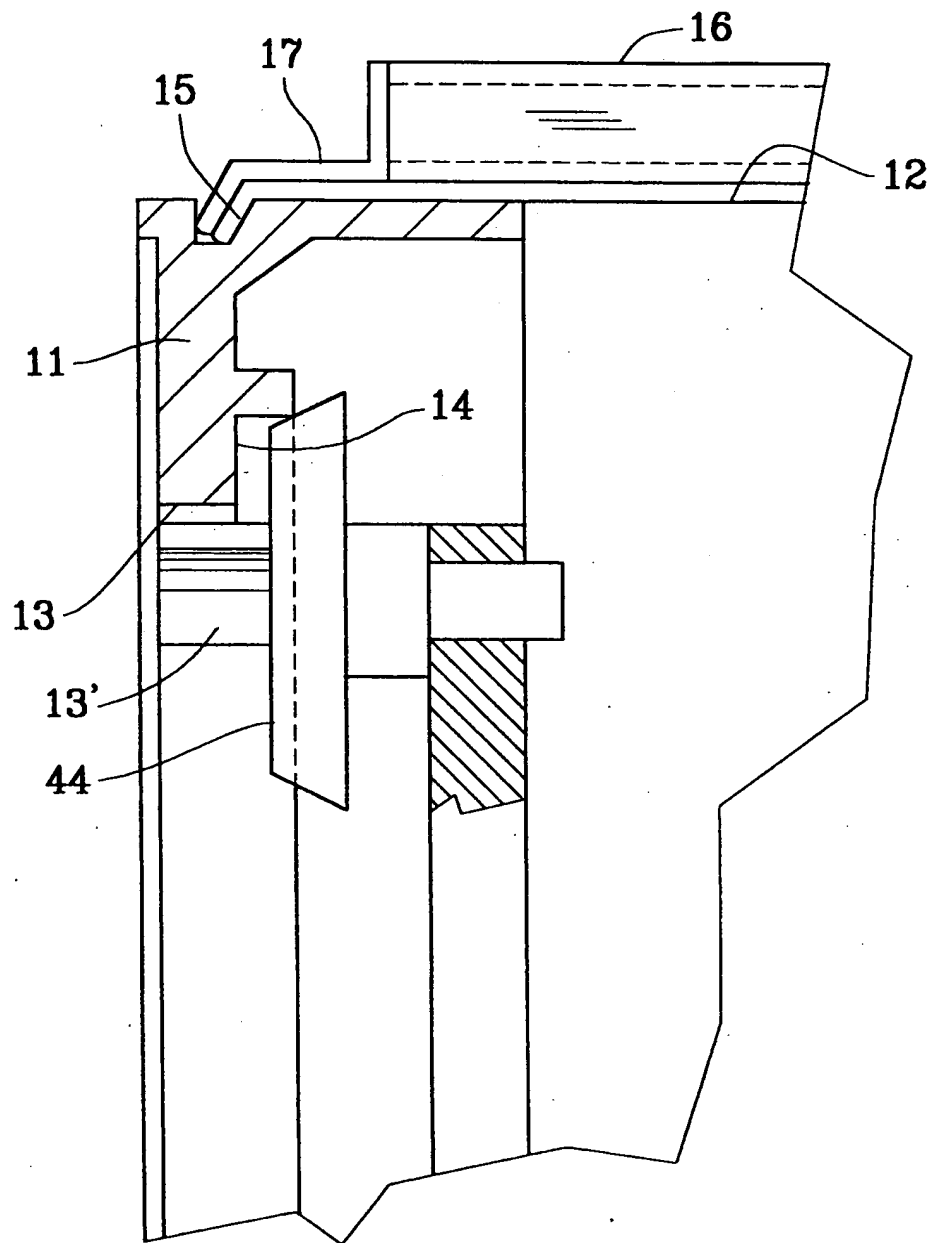
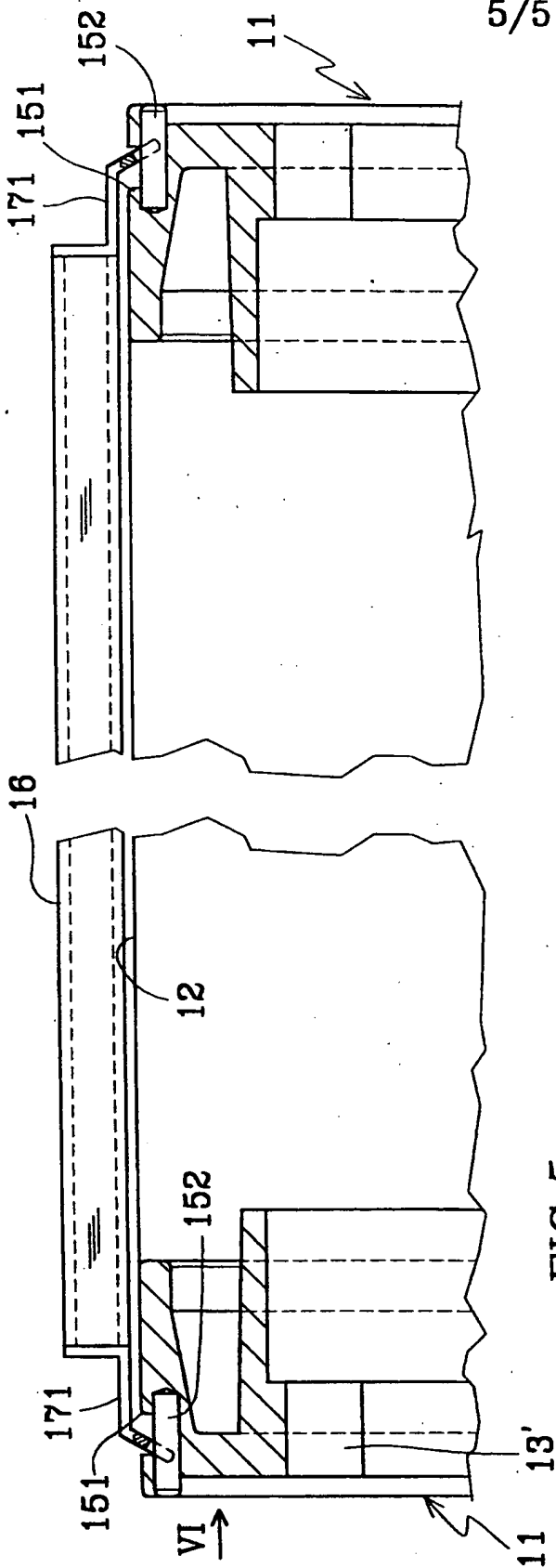


FIG. 3

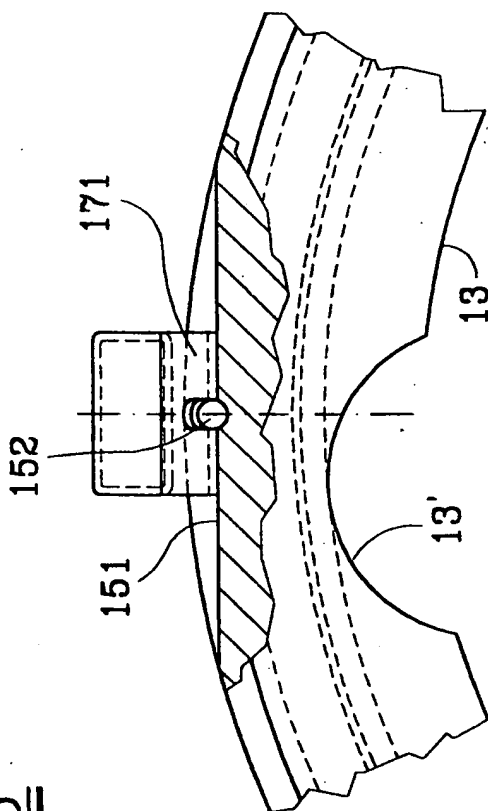
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FIG. 4





**FIG. 5**



**FIG. 6**

## INTERNATIONAL SEARCH REPORT

Int ional Application No

PCT/EP 96/02871

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 B41F15/38

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B41F B41L

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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